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Homogeneity-Driven Technology Independence in HL7 Paradigms

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BACKGROUND: The Medical fraternity and the healthcare service sector have long acknowledged the need for smart, IT-based, *interoperable* healthcare systems. *Semantic Interoperability* is key which is the regulated, authorized, meaningful exchange, storage, management, and access to valued healthcare information. This cues in *Health Level Seven (HL7)*, the predominant global healthcare standard in operation today. Introduced in 1987 by the *HL7 International Inc.*, its current *version 3* has been found to be complex and difficult to implement and maintain. Global *semantic interoperability* termed *International Interoperability* herein, an *inceptive* goal of the *HL7* standard, is still an illusion.

OBJECTIVE: This study focuses on the belief that the achievement of true *International Interoperability* and associated *Inclusive Efficiency* during operation is rooted at the labyrinths of specifications development sub-processes. Infusing simplicity and uniformity in the *paradigmatic modelling* phase derives optimal *analytic, design, and semantic interoperability*, which would permeate to true *International Interoperability* in application. Modelling paradigmatic *Artifacts* using the newly-devised, *techno-platform independant Unified Data Atom (UDA*)* representation infuses simplicity, brevity, and versatility into the design process. This would also promote and enhance numerous allied activities such as domain requirements cross-checking, audit, and consensus, to *kindred* system development verification and validation. This paper therefore propounds a significant first step which is the injection of *homogeneity-driven technology independance* in *HL7* paradigmatic representations.

METHOD: The *HL7 v3* specifications creation continuum is *tri-paradigmatic*, consisting of *Messages, Clinical Document Architecture (CDA), and Services*, all presently modelled using the *Extended Markup Language (XML)*. *XML* which was introduced by the *World Wide Web Consortium (W3C)* in 1996, is a *Markup* language used for formatting human and machine readable documents. Our proposed solution remodels all *XML-based* paradigmatic artifacts using the *UDA* vocabulary, either first-hand or as a single-step transliteration. This creates *overarching homogeneity* across all three *HL7* paradigmatic *landscapes* and their nascent specification development sub-processes, and is therefore a *leapfrog* in all current *HL7* implementation goals. The result is the achievement of true sub-process *interoperability* during design and development which in turn would promote the development of efficient, *globally-interoperable* system specifications.

Typical XML Message Segment – derived from [1]

```
<?xml version="1.0" encoding="UTF-8" ?>
< PRPA_IN101001UV01 ITSVersion="XML_1.0"
  xmlns="urn:hl7-org:v3"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema
    ma-instance">
  <receiver>
    <device>
      <id extension="922"
        root="2.16.840.1.113883.19.9"/>
      <name>Master MPI</name>
      .....
      <representedOrganization>
        <id extension="1002003"
          root="2.16.840.1.113883.19.200"/>
        <name>Alpha Hospital</name>
      </representedOrganization>
    </asAgent>
  </device>
</receiver>
```

RESULTS: If U^+ denotes the set of transliterated, target *DataAtoms* $\{u_1, u_2, u_3, u_4, \dots, u_k\}$ as a result of the *Equivalence* relation T^+ acting on the source *XML* informational schema X (either a *Message*, *Document*, or *Service*), then

$$T^+ : X \rightarrow U^+ \rightarrow (1) \text{ where}$$

X - Problem domain *XML* super schema and

U^+ - Problem-related target *UDA*^{*} super schema

$$U^+ \in \mathbf{U}(u_i \leftrightarrow u_j) \rightarrow (2) \\ \{i, j, = 1, 2, \dots, k\}$$

where U^+ : set of target *DataAtoms* with implicit, complete interconnectivity, and

\mathbf{U} : union of bidirectionally inter-connected, target *DataAtom* pairings.

This proposed solution successfully proved that T^+ is an *Equivalence* relation being *Reflexive*, *Symmetric*, and *Transitive*. This confirms that the mapping T^+ produces a target set U^+ equivalent to the source set X . In addition, it was also proved that the algorithm T^+ is *Complete and Exhaustive*.

DISCUSSION AND CONCLUSIONS: This paper focused on excavating and capitalizing on the abounding interoperability potential afforded by core *paradigm-related* specification development processes, and synergistically aggregating to achieve this exigent goal. Our proposed solution remodels all *HL7* paradigmic artifacts in the *techno-platform independent UDA*^{*} representation, either first-hand or as a single-step transliteration, with a view to accruing the *inclusive* benefits of simplicity, brevity, and versatility over the previous *XML* representation. Principally significant is that *analysis and design interoperability* amongst all stakeholders also derived as a fillip in addition to providing a secure approach to actualize overarching, ubiquitous exchange.

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